Peri-anchor cyst formation after arthroscopic Bankart repair: Comparison between biocomposite suture anchor and all-suture anchor

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Directed by Professor Yong-Min Chun

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This certifies that the Master's Thesis of
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Through my master's course, it became a great opportunity to grow one step further as an orthopedic surgeon. I will do my best in the future so that all of these can be the foundation for becoming a doctor who is dedicated to the patients. Thank you.

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ABSTRACT

Peri-anchor cyst formation after arthroscopic Bankart repair: Comparison between biocomposite suture anchor and all-suture anchor

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Purpose: The purpose of this study is to investigate clinical outcomes and radiological findings of cyst formation in the glenoid around suture anchors after arthroscopic Bankart repair with either biocomposite suture anchor or all-suture anchor in traumatic anterior shoulder instability. We hypothesized that there would be no significant difference in clinical and radiological outcomes between the two suture materials.

Methods: This retrospective study reviewed 162 patients (69 in Group A, biocomposite anchor; 93 in Group B, all-suture anchor) who underwent arthroscopic Bankart repair of traumatic recurrent anterior shoulder instability with less than 20% glenoid defect on preoperative en-face view 3-dimensional (3D) computed tomography (CT). Patient assignment was not randomized.

Results: At final follow-up, the mean SSV, Rowe score, and UCLA shoulder score improved significantly in both groups. However, there was no significant difference in functional shoulder scores and recurrence rate (6%, 4/69 in Group A; 5%, 5/93 in Group B) between the two groups.

On follow-up MRA/CTA, the incidence of peri-anchor cyst formation was 5.7% (4/69) in Group A and 3.2% (3/93) in Group B, which was not a significant difference.

Conclusions: Considering the low incidence of peri-anchor cyst formation in the glenoid after arthroscopic Bankart repair with one of two anchor systems and the lack of association with recurrence instability, biocomposite and all-suture anchors in arthroscopic Bankart repair yield satisfactory outcomes with no significant difference.

Key words: peri-anchor cyst, arthroscopic bankart repair, biocomposite suture anchor, all-suture anchor

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I. INTRODUCTION

The shoulder is a commonly dislocated joint in the human body. In young patients, recurrence of shoulder instability can occur in up to 90% with some surgical options[1-3]. With the advent and development of suture anchors, arthroscopic Bankart repair has replaced open Bankart repair with a classic transosseous technique. Furthermore, suture anchor has become one of the most important factors for restoration of recurrent shoulder instability[4,5].

The first generation of suture anchors comprised metallic materials (stainless steel or titanium) and could produce stable fixation and satisfactory clinical outcomes. However, many severe complications were reported, such as loosening, intra-articular migration, and protrusion into the shoulder joint resulting in cartilage injury[6-10]. Thereafter, non-metallic second-generation (bioabsorbable and biocomposite) suture anchors were introduced to overcome these complications and are widely used in the arthroscopic field[6,10,11]. Nonetheless, there have been issues related with rapid degradation leading to

intraosseous cyst formation and osteolysis[10,12].

Recently, a third generation of suture anchors (all-suture type) was introduced. These all-suture anchors avoid osteolysis due to degradation or cartilage injury caused by a loose body. However, a recent study raised the concern that the all-suture-type anchor created a cyst-like cavity in vivo and resulted in inferior biomechanical properties except ultimate failure load compared to biocomposite suture anchor[13].

The purpose of this study is to investigate clinical outcomes and radiological findings regarding cyst formation in the glenoid around suture anchors after arthroscopic Bankart repair with either biocomposite suture anchor or all-suture anchor in traumatic anterior shoulder instability. We hypothesized that there would be no significant difference in clinical and radiological outcomes between the two suture materials.

II. MATERIALS AND METHODS

1. Study population

This retrospective study reviewed 211 patients who underwent arthroscopic Bankart repair of traumatic recurrent anterior shoulder instability using either biocomposite suture anchor (SutureTak, Arthrex, Naples, Florida, Group A) or all-suture anchor (Y-Knot Flex, ConMed Linvatec, Largo, Florida, Group B) performed by a senior author from January 2011 to February 2017. Patient assignment was not randomized. The indications of surgery were discomfort in activities of daily-living and positive apprehension test. The inclusion criteria were Bankart lesion with less than 20% glenoid defect on preoperative en-face 3-dimensional (3D) computed tomography (CT) and (2) available for a minimum 2-year follow-up after surgery. The exclusion criteria

were (1) previous operative history on affected shoulder, (2) revision surgery, (3) unavailability for at least 2 years of follow-up, (4) concomitant rotator cuff repair, (5) combined posterior or multi-directional instability, and (6) lack of follow up magnetic resonance arthrography (MRA) or computed tomography arthrography (CTA) after 6 months postoperatively. Finally, 162 patients (69 in Group A, biocomposite anchor; 93 in Group B, all-suture anchor) who satisfied the inclusion and exclusion criteria and their medical records and radiologic data were reviewed retrospectively. This study was approved by the Institutional Review Board of Severance Hospital, Yonsei University College of Medicine, with waver of the requirement for patient-informed consent.

2. Functional and radiologic assessments

Functional assessments were performed using the following indices: subjective shoulder value (SSV; the percentage value of the affected shoulder compared to that of the normal shoulder), Rowe score, University of California, Los Angeles (UCLA) shoulder score, and shoulder active range of motion (ROM; forward flexion in the scapular plane, external rotation with the elbow at the side and external and internal rotation in 90 degrees of abduction). During each patient visit, an independent examiner evaluated the preoperative and postoperative shoulder functional scores and measured active ROM. We defined recurrence instability as subluxation episode, re-dislocation, or positive apprehension sign at 90° abduction and external rotation of the shoulder. Preoperative radiologic assessments included standing true anteroposterior (AP) views of the shoulder in neutral and axillary positions and MRI or MRA studies. Follow-up MRA (3.0-T MR imaging unit, MAGNETOM Tim Trio; Siemens, Erlangen, Germany) or CTA (SOMATOM Sensation 64; Siemens) was performed 6 months after operation.

3. Surgical techniques and postoperative rehabilitation

All patients underwent arthroscopic Bankart repair in lateral decubitus position under general anesthesia in the setting of longitudinal traction with 10 lbs. A superior viewing portal, low anterior portal for anchor insertion, and posterior portal for shuttle relay were established. Viewed from the superior portal, a Bankart lesion was identified. After sufficient release of detached anteroinferior labrum, the glenoid edge was prepared. The first anchor was inserted at the 5 o'clock of the glenoid rim in the right shoulder (7 o'clock in the left shoulder), and the suture was passed through the capsule. After shuttle-relay, a knot was secured on the capsular side of the labrum. In the same manner, the subsequent two or three anchors were inserted and secured in a row.

After surgery, the shoulder was held in an abduction brace for four to five weeks. A self-assisted circumduction exercise was initiated the day after surgery. Self-assisted passive ROM exercises were initiated as tolerated after removal of the brace. Self-assisted active ROM exercises were initiated eight weeks after surgery. Isotonic strengthening exercises with an elastic band were encouraged three months after surgery. The patients were allowed to return to their premorbid level of sports activities six months after surgery.

4. Statistical analysis

Statistical analysis was performed using the SPSS program (IBM SPSS statistics version 23.0, IBM Corp., Armnok, NY, USA). Student's t test was used to compare continuous or continuous ranked data, such as shoulder functional scores (SSV, Rowe, UCLA) and ROM between groups. Paired t-test was used to compare preoperative and postoperative values within each group.

The Chi-square test was used to compare categorical data such as presence of cyst and recurrence instability. Statistical significance was set at $p<0.05$.

III. RESULTS

Patient demographics are summarized in Table 1, and there was no significant difference in any metric between the two groups. At final follow-up, the mean SSV, Rowe score, and UCLA shoulder score improved significantly in both groups: mean SSV improved from 40.1 to 93.2 in Group A ($p < 0.001$) and from 40.9 to 92.8 in Group B ($p < 0.001$); mean Rowe score improved from 46.1 to 91.6 in Group A ($p < 0.001$) and from 47.2 to 90.9 in Group B ($p < 0.001$); mean UCLA shoulder score improved significantly from 22.9 to 32.3 in Group A ($p < 0.001$) and from 23.5 to 32.5 in Group B ($p < 0.001$). There was no significant difference in these functional scores between the two groups (Table 2). During the study period, instability recurred in 4 patients (6%, 4/69) in Group A and 5 patients (5%, 5/93) in Group B, with no significant difference.

Table 1. Patient demographics

	Group A (N=69)	**Group B (N=93)**	**p-value**
Sex	65/4	87/6	0.864
Age	22.8 ± 6.2 (17 to 42)	23.4 ± 5.9 (16 to 44)	0.793
Symptom period (months)	19.8 ± 6.9 (9 to 52)	21.6 ± 7.7 (10 to 60)	0.616
Mean period of follow-up (months)	41.2 ± 13.2 (24 to 96)	34.7 ± 9.3 (24 to 60)	0.133
Number of suture anchors	3.7 ± 0.2 (3 to 5)	3.9 ± 0.2 (3 to 5)	0.483

Additional remplissage	4	5	0.864

Group A, biocomposite anchor; Group B, all suture anchor. The values are given as the mean and standard deviation.

Table 2. Preoperative and final follow-up shoulder functional scores for both groups

	Group A (N=69)	**Group B (N=93)**	**p-value**
Preoperative SSV	40.1 ± 15.6	40.9 ± 13.9	0.254
Final follow-up SSV	93.2 ± 3.6	92.8 ± 4.3	0.756
Preoperative Rowe score	46.1 ± 5.3	47.2 ± 4.9	0.512
Final follow-up Rowe score	91.6 ± 6.4	90.9 ± 6.2	0.811
Preoperative UCLA shoulder score	22.9 ± 1.7	23.5 ± 2.1	0.316
Final follow-up UCLA shoulder score	32.3 ± 2.4	32.5 ± 2.1	0.854

Group A, biocomposite anchor; Group B, all suture anchor. The values are given as the mean and standard deviation.

On preoperative 3-D CT, the mean glenoid defect percentage was 15.6 % ± 3.3 % in Group A and 14.9 % ± 3.4 % in Group B. There was no significant difference between the two groups. On follow-up MRA/CTA, the incidence of peri-anchor cyst formation was 5.7% (4/69) in Group A and 3.2% (3/93) in Group B, with no significant difference.

IV. DISCUSSION

The purpose of this study is to investigate clinical outcomes and radiological findings regarding cyst formation in the glenoid around suture

anchors after arthroscopic Bankart repair with either biocomposite suture anchor or all-suture anchor in traumatic anterior shoulder instability. As we hypothesized, there was no significant difference in clinical outcomes including recurrence instability and incidence of peri-anchor cyst formation.

The bone reaction around the anchor is a complication after use of bioabsorbable anchors in the shoulder, and peri-anchor reaction has occurred in the glenoid after SLAP or Bankart repair as well as in the humeral head after rotator cuff repair[10,11,14]. Milewski et al. reported bone replacement of biocomposite anchor in labral repair[11]. In their study, 98% of anchor material was absorbed, 78% was replaced by soft tissue of variable density, and 20% was replaced by bone at 24 months after surgery. Three of 47 anchors (6.3%) showed peri-anchor cyst formation, which was similar to the incidence (7.2%) of the current study. Kim et al. investigated the incidence of osteolysis and cyst formation after use of bioabsorbable anchors in rotator cuff repair[10]. The incidence was 46.4% with variable grades of osteolysis, and they indicated that use of this bioabsorbable anchor should be reconsidered due to interference in revision surgery considering preservation of bone stock in the setting of adequate anchor resorption.

All-suture anchor was introduced in 2010[15], to eliminate or reduce the concerns of bioabsorbable or biocomposite suture anchors, and recent studies underscored its clinical implications[15-17]. Although all-suture anchors have equivalent ultimate failure load to the traditional solid anchor system[18,19], Pfeiffer et al. revealed in their in vivo study that this all-suture anchor system produced increased tunnel width and greater displacement under cyclic load[13]. Tompane et al. demonstrated that all-suture anchor yielded a low rate of cyst formation, and tunnel expansion greater than 80% was found in most patients at 12-month follow-up. However, this increased tunnel volume was not associated with clinical outcomes and recurrence instability. Lee et al. compared the

all-suture anchor with biodegradable anchor in arthroscopic Bankart repair[16] and found that tunnel expansion was significantly greater in the all-suture anchor at 1-year follow-up, although it was not associated with clinical outcomes including recurrence instability during the study period. Similarly, the current study showed no significant difference in cyst formation (5.7% vs. 3.2%) at 6-month follow-up MRA/CTA or in clinical outcomes and recurrence instability.

Nakagawa et al. raised the concern that cystic change and tunnel expansion in the glenoid might increase some unknown risk for anterior glenoid rim, especially in the setting of linear arrangement of multiple all-suture anchors[20]. Although a large number of anchors were not always associated with glenoid rim fracture, they suggested that linear placement of suture anchors might induce weakness of the glenoid fossa and following glenoid rim fracture. Park et al. reported similar cases of anterior glenoid rim fracture after arthroscopic Bankart repair[21]. They used metal or bioabsorbable anchors and indicated that osteolysis around the suture anchor, especially without ceramic composite, might lead to rim fracture. In the current study, there was no glenoid rim fracture after arthroscopic Bankart repair.

There are several limitations to this study. First, this is a non-randomized retrospective study that has inherent selection bias for patient assignment. In the early study period, the biocomposite anchor was used, while the all-suture anchor was used later in the study. Second, the lack of significant difference in clinical outcomes might be due to the low statistical power resulting from the small number of patients. Third, we could not analyze tunnel expansion but only cyst formation because MRA was used in many cases. Fourth, follow-up MRA/CTA was performed 6 months after surgery, which may not be long enough to evaluate peri-anchor cyst formation.

V. CONCLUSION

Considering the low incidence of peri-anchor cyst formation in the glenoid after arthroscopic Bankart repair with the two anchor systems and the lack of association with recurrence instability, biocomposite and all-suture anchors in arthroscopic Bankart repair can yield satisfactory outcomes with no significant difference.

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ABSTRACT (IN KOREAN)

관절경하 방카르트 봉합술 후 나사못 주위 낭종 형성: 생체복합재료 봉합나사못과 모든-봉합나사못의 비교

<지도교수 **천용민**>

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진 석 환

목적: 이 연구의 목적은 외상성 견관절 전방 불안정성에 대해 생체복합재료 봉합나사못 또는 모든-봉합나사못을 이용한 관절경하 방카르트 봉합술 시행 후 임상 결과와 관절와에 생긴 봉합나사못 주위 낭종 형성의 영상 소견을 조사하는 것이다. 이에 저자들은 두 봉합나사못을 사용한 환자군 사이에 임상 결과와 영상 결과의 유의미한 차이는 없을 것이라는 가설을 세웠다.

대상 및 방법: 이 후향적 연구는 수술 전 3차원 컴퓨터단층촬영상 관절와 손상이 20% 미만인 외상성 재발성 견관절 전방 불안정성이 있는 환자 중 관절경하 방카르트 봉합술을 받은 162명 (A그룹의 69명, 생체복합재료 봉합나사못; B그룹의 93명, 모든-봉합나사못) 을 대상으로 하였다. 환자 선정은 무작위로 하지 않았다.

결과: 마지막 추시 관찰 시, 두 환자군에서 평균 subjective shoulder value (SSV), Rowe 점수, UCLA 어깨 점수가 유의미하게

증가하였다. 하지만, 두 환자군 사이에서 기능적 어깨 점수와 수술 후 재발률 (A그룹에서 6%, 4/69; B그룹에서 5%, 5/93) 은 유의미한 차이를 보이지 않았다. 수술 후 시행한 자기공명조영술이나 컴퓨터단층조영술에서 그룹 A는 5.7% (4/69), 그룹 B는 3.2% (3/93) 가 봉합나사못 주위 낭종 형성을 보였다. 하지만, 두 환자군 사이에서 유의미한 차이는 없었다.

결론: 두 나사못 체계 중 어느 방법을 선택해도 관절경하 방카르트 봉합술 후 관절와에 생긴 봉합나사못 주위 낭종 형성의 발생률이 낮다는 점과 수술 후 재발 불안정성과 연관성이 부족하다는 점을 고려할 때, 생체복합재료 봉합나사못 또는 모든-봉합나사못을 이용한 관절경하 방카르트 봉합술은 서로 유의미한 차이 없이 만족할 만한 결과를 얻을 수 있다.

핵심되는 말: 나사못 주위 낭종, 관절경하 방카르트 봉합술, 생체복합재료 봉합나사못, 모든-봉합나사못

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